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3. WASTE MATRIX PHYSICAL AND CHEMICAL COMPOSITION CHARACTERIZATION

The bulk of the stored wastes consist of physical mixtures of various materials and components generally in solid form, with some absorbed liquids. This section describes the stored waste inventory in terms of the relative mass fractions of the components and materials which make up the bulk waste matrix. An estimate of the chemical composition of those waste matrix materials is also provided. This information represents best estimates of the waste matrix composition to date based on engineering evaluation of previous characterization documentation and available waste generator process information. The information provided in this section is based on work by Gale (1994)^a and Raivo (1995).^b

Figure 3-1 and Table 3-1 present summary distribution of the waste matrix by component for ALLW and TRUW combined. Table 3-1 includes matrix identification codes per current DOE Waste Treatability Group Guidance.³⁻¹

Design basis estimates for chemical analysis for each constituent comprising the general waste matrix are presented in Tables 3-2, 3-3 and 3-4. Table 3-2 presents an estimate of chemical composition (elemental plus water and inert) of the constituents defined in the appendices. Table 3-3 presents an estimation of chemical composition of the inert fraction of constituents listed in Table 3-2 expressed as a fraction of the inert chemicals. Table 3-4 presents an estimation of chemical composition of the inert fraction of constituents listed in Table 3-2 expressed as a fraction of the total constituent chemicals.

Although not categorized as a stored INEL TSA waste stream, variable amounts of INEL RWMC soil may also be included for treatment as a result of retrieval efforts. Tables 3-5, 3-6, 3-7 and 3-8 present typical characterization information for RWMC soil derived from actual soil samples.³⁻² Table 3-5 presents particle size distribution and density information. Table 3-6 presents cation exchange capacity information. Table 3-7 presents a mineral content analysis, and Table 3-8 presents a chemical content analysis of RWMC soil.

Also, some soil from the Rocky Flats Plant past operations may be included as waste in the stored TSA waste. Tables 3-2, 3-3, and 3-4 present general estimated composition values for RFP soil. The detailed data in the appendices provide estimates of RFP soil content in the waste at the content code level. Tables 3-9, 3-10, 3-11, and 3-12 present additional characterization information for RFP soil derived from actual soil samples.³⁻² Table 3-9 presents particle size distribution and density information. Table 3-10 presents cation exchange capacity information. Table 3-11 presents a mineral content analysis, and Table 3-12 presents a chemical content analysis of RFP soil.

Both RWMC and RFP soil can be subjectively categorized as being very abrasive to operating (e.g., rotating) machinery.

a. L. G. Gale, Estimated Waste Matrix Compositions of ALLW for Treatment Design Basis, EDF IWPF-0047, February 1994.

b. B. D. Raivo, Estimated Waste Matrix Compositions of INEL stored waste, EDF PSPI-015546-14, December 15, 1995.

Table 3-1. INEL alpha contaminated waste matrix composition summary by component.^a

Matrix code ^b	Waste matrix component ^c	Component mass (kg) ^d	Fraction of total identified mass	Estimated percent distribution of total estimated mass ^e
S3113	Group [Absorbed Liquids]	2.0690e+05	0.0079	0.790
S3121	Group [Absorbents]	8.5000e+03	0.00032	0.032
S3112	Group [Aluminum (metal or oxide form)]	3.6920e+03	0.00014	0.014
S3121	Group [Aqueous Solutions]	2.3800e+05	0.00909	0.909
S5410	Group [Asbestos filters and insulation]	2.5060e+05	0.00957	0.957
S3111	Group [Ash]	1.3350e+04	0.00051	0.051
S5450	Group [Asphalt]	2.5180e+05	0.00961	0.961
S5440	Group [Benelex/lead]	2.2010e+04	0.00084	0.084
S3114	Group [Calcium Silicate]	6.9140e+05	0.02639	2.639
S5111	Group [Carbon Steel]	3.6100e+06	0.13777	13.777
S5330	Group [Cardboard]	2.1140e+05	0.00807	0.807
S5330	Group [Cellulosics]	7.9800e+02	0.00003	0.003
S5123	Group [Ceramic Molds]	4.1980e+04	0.0016	0.160
S3113	Group [Clay]	2.9900e+05	0.01141	1.141
S5330	Group [Cloth]	2.3890e+05	0.00912	0.912
S3150	Group [Concrete]	4.4900e+05	0.01714	1.714
S4100	Group [Dirt/Soil]	5.2160e+05	0.01991	1.991
S5410	Group [Filter dust]	6.7750e+04	0.00259	0.259
S5320	Group [Filters]	3.7990e+04	0.00145	0.145
S5123	Group [Firebrick]	1.7270e+05	0.00659	0.659
S5410	Group [Glass filter media]	3.0600e+05	0.01168	1.168
S3117	Group [Glass Rashig Rings]	1.9650e+05	0.0075	0.750
S5126	Group [Graphite molds]	2.3340e+05	0.00891	0.891
S3110	Group [Graphite]	1.5590e+03	0.00006	0.006
X7211	Group [Lead (Bulk Pb)]	2.7510e+05	0.0105	1.050
X7210	Group [Lead Shielding]	6.2000e+02	0.00002	0.002
S5311	Group [Leaded Rubber]	2.5000e+05	0.00954	0.954
S3100	Group [Miscellaneous Sources]	0.0000e+00	0	0.000
S3113	Group [Oil-dri]	3.8100e+05	0.01454	1.454
S3114	Group [Organic Shudge]	1.1030e+06	0.04211	4.211
S5122	Group [Other Glass]	3.4320e+05	0.0131	1.310
S5110	Group [Other metals]	1.6320e+06	0.06229	6.229
S5330	Group [Paper/Cloth]	1.1370e+03	0.00004	0.004
S5330	Group [Paper]	1.4320e+06	0.05465	5.465
S3113	Group [Plaster of Paris]	8.5000e+02	0.00003	0.003
S5310	Group [Plastics]	2.5150e+06	0.096	9.600
S5313	Group [Plexiglass]	9.9160e+04	0.00378	0.378
S3121	Group [Portland Cement]	8.3660e+05	0.03193	3.193
S3211	Group [Resin]	1.4760e+04	0.00056	0.056
S5310	Group [Rubber]	7.2190e+04	0.00276	0.276
S3140	Group [Salts]	1.9430e+04	0.00074	0.074

Table 3-1. (continued).

Matrix code ^b	Waste matrix component ^c	Component mass (kg) ^d	Fraction of total identified mass	Estimated percent distribution of total estimated mass ^e
S5120	Group [Sheetrock]	1.1160e+05	0.00426	0.426
S3121	Group [Sludge - 1st Stage]	1.2270e+06	0.04683	4.683
S3121	Group [Sludge - 2nd Stage]	1.2270e+06	0.04683	4.683
S3121	Group [Sludge]	4.0490e+06	0.15454	15.454
S5111	Group [Stainless Steel]	1.2100e+06	0.04617	4.617
S5310	Group [Surgeons' gloves]	3.1690e+05	0.0121	1.210
S5111	Group [Tantalum (10W)]	3.8440e+04	0.00147	0.147
S3211	Group [Uncemented Resin]	9.1840e+03	0.00035	0.035
S5100	Group [Unknown Inorganics]	7.1090e+03	0.00027	0.027
S3113	Group [Vermiculite]	4.2910e+05	0.01638	1.638
S5320	Group [Wood]	4.9320e+05	0.01883	1.883
	Non-group Components ^f	3.2042e+03	0.00011	0.011
	Total	2.6173e+07	1.00	100

a. EDF PSPI-015546-14, 12/15/95.

b. Matrix codes per DOE Waste Treatability Group Guidance, DOE/LLW-217, Rev. 0, January 1995.

c. As derived from rollup of the IMWI database %wt composition splits as of 9/95, which are based on A. L. Rubert, References for Descriptions and Matrix Compositions of Corrosion Code Wastes Stored at the Transuranic Storage Area, IMWI-EDF-004, June 21, 1995; L. G. Gale, B. D. Raivo, Estimated Waste Matrix Compositions of a-LL Waste for Treatment Design Bases, IWPF-EDF-0047, June 22, 1994; and current updates provided in IMWI.

d. As derived from rollup of database %wt composition splits.

e. Estimated total mass of INEL alpha-contaminated waste is 3.19E+07 kg (6.49E+04 m³).

f. Other minor matrix components similar to, but not in the group categories, may be assigned to individual waste streams; see detailed information and electronic tables.

Table 3-2. Chemical composition of waste constituents of the waste stored in the TSA.

Matrix Code (a)	Waste Matrix Component (b)	Constituent (b)	Wt% of waste constituent							Inert	References / Notes
			Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur	Chlorine	Fluorine		
S3117	Group [Glass Rasching Rings]	Glass Rasching rings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5122	Group [Other Glass]	Other glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5111	Group [Carbon Steel]	Carbon steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5112	Group [Stainless Steel]	Stainless steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3112	Group [Aluminum (metal or oxide form)]	Aluminum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5111	Group [Titanium (10W)]	Titanium 10W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
X7211	Group [Lead (Bulk, Pb)]	Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Group [Lead (Bulk, Pb)] same inert composition as Lead from L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
X7210	Group [Lead Shielding]	Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Group [Lead Shielding] same inert composition as Lead from L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5110	Group [Other metals]	0.999 Misc. Metals:0.001HVPM Miscellaneous metal HVPM (Zn, Cd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	Ratio Group [Other Metals] to 0.999 Misc Metals:0.001 HVPM based on Content Code 480 and IMWI total estimated masses for content codes and EDF 0047 for Misc. Metal to HVPM splits.
S5123	Group [Ceramic Molds]	Miscellaneous Non-Combustible Ceramic molds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3123	Group [Firebrick]	Firebrick	0.00	0.00	0.00	0.00	0.00	0.00	0.00	97.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3150	Group [Concrete]	Concrete	0.00	0.00	0.00	0.00	0.00	0.00	0.00	91.28	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3121	Group [Portland Cement]	Portland cement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S4100	Group [Dirty Soil]	Dirty soil (RFP)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3111	Group [Ash]	Ash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3113	Group [Oil-dri]	Oil-Dri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3113	Group [Vermiculite]	Vermiculite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3140	Group [Salts]	Evap. salts—CC #5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5100	Group [Unknown Inorganics]	Evap. salts—CC #5	0.85	0.13	0.00	0.00	0.00	0.00	0.00	98.88	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3114	Group [Calcium Silicate]										
S3113	Group [Clay]										
S3121	Group [Absorbents]										
S3113	Group [Plaster of Paris]										
S3100	Group [Miscellaneous Sources]										
S5320	Group [Filters]	Filters/Insulation Wood	46.94	5.00	35.61	0.00	0.05	0.00	0.00	2.42	Assume inert fractions same composition as wood per IMPF EDF-0047, Content Code 30.
S5410	Group [Glass filter media]	Glass filter media	3.96	0.54	0.00	0.00	0.00	0.00	0.00	90.50	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5410	Group [Asbestos filters and insulation]	Asbestos filter media Magnesia (insulation)	3.96	0.54	0.00	0.00	0.00	0.00	0.00	90.50	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5410	Group [Filter dust]	Filter dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3121	Group [Sludge - 1st Stage]	Inorganic Sludge 0.5 high Na2O:0.5 high CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	From IMPF EDF-0047, (CC 7), group [Sludge] is 50% 1st Stage, 50% 2nd Stage sludge.
S3121	Group [Sludge - 2nd Stage]	Sludge—high CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3121	Group [Aqueous Solutions]	Aqueous solutions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5311	Group [Leaded Rubber]	Partially Combustible Leaded rubber	33.16	4.47	1.01	0.28	0.51	0.00	0.00	60.56	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3114	Group [Organic Sludge]	Organic sludge	26.69	3.65	0.00	0.00	0.00	0.00	0.00	29.97	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3211	Group [Uncemented Resin]	Uncemented resin Cemented resins	63.03	6.97	0.00	0.00	0.00	0.00	0.00	0.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3211	Group [Resin]	Uncemented resin	63.03	6.97	0.00	0.00	0.00	0.00	0.00	0.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5450	Group [Asphalt]	Asphalt	4.29	0.49	0.05	0.05	0.12	0.00	0.00	95.01	EDF 0047 cemented resin consists of resin and portland cement. IMWI Group identifiers split the cemented resin into resin and portland cement. (Ex. Content Code 432). Use inert fraction for Group [Uncemented Resin] for the Group [Resin].
S5460	Group [Benzene/lead]	Benzene/lead	33.20	3.53	25.19	0.00	0.03	0.00	0.00	34.70	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5120	Group [Sheetrock]	Sheetrock	0.41	0.06	0.42	0.00	0.00	0.00	0.00	76.34	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3113	Group [Absorbed Liquids]										
S5310	Group [Plastics]	Combustibles Plastics 0.800 Poly:0.199 PVC:0.001 Teflon	77.40	11.86	2.09	0.09	0.02	0.08	0.00	1.36	The plastic ratio (0.8 Poly:0.199 PVC:0.001 Teflon) From EDF 0047 is based on the narrative in EGG-WM-6503 and WM-F-828021 (WASTDAT7.wk3).
S5310	Group [Rubber]	Rubber	84.93	13.40	0.35	0.11	0.02	0.00	0.00	1.19	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5310	Group [Surgeons' gloves]	Surgeons' glove	47.38	5.73	9.09	0.00	0.01	0.00	0.00	2.07	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S3110	Group [Graphite]	Miscellaneous Combustibles Graphite	24.00	0.00	0.00	0.00	0.00	76.00	0.00	0.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Paper/Cloth]	Paper/Cloth	59.99	8.05	31.96	0.00	0.00	0.00	0.00	0.00	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Paper]	Paper	76.23	10.26	2.32	0.65	1.18	0.00	0.00	9.34	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Cloth]	Cloth	76.23	10.26	2.32	0.65	1.18	0.00	0.00	9.34	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5320	Group [Wood]	Wood	99.19	0.70	0.00	0.00	0.01	0.00	0.00	0.10	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Cardboard]	Cardboard	99.19	0.70	0.00	0.00	0.01	0.00	0.00	0.10	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Cellulosics]	Paper, Cardboard	49.54	5.27	37.59	0.00	0.05	0.00	0.00	2.55	Assume inert fraction composition is the same as Graphite.
S5330	Group [Cellulosics]	Paper, Cardboard	49.54	5.27	37.59	0.00	0.05	0.00	0.00	2.55	Assume 50:50 paper/cloth split with composition from EDF-0047.
S5330	Group [Cellulosics]	Paper, Cardboard	49.54	5.27	37.59	0.00	0.05	0.00	0.00	2.55	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Cellulosics]	Paper, Cardboard	49.54	5.27	37.59	0.00	0.05	0.00	0.00	2.55	L.G. Gale, B.D. Raivo, IMPF EDF-0047, 6/22/94
S5330	Group [Cellulosics]	Paper, Cardboard	49.54	5.27	37.59	0.00	0.05	0.00	0.00	2.55	Assume inert fractions same composition as Paper, Cardboard per IMWI EDF-0047.

(a) Matrix Codes per DOE Waste Treatability Group Guidance, DOE/LW-217, Rev. 0, January 1995; Matrix Component Groupings per IMWI 995 with reference to IMWI EDF-004, A.L. Rubert, June 21, 1995.
 (b) IMPF EDF 0047, L.G. Gale, June 22, 1994

Table 3-5. Particle size distribution and mean density of RWMC soil.^a

Particle size distribution of as received RWMC soil

Particle size (mm)	Wt%	Cumulative Wt%
-0.075	10.98	10.98
0.075-0.15	15.35	26.33
0.15-0.3	5.63	31.96
0.3-0.6	6.64	38.60
0.6-1	5.98	44.58
1-2.36	12.98	57.56
2.36-25.0	42.44	100

Particle size and density distribution of RWMC soil. Portion <1 mm blended (44.5% < 1 mm).

Particle size (mm)	Wt%	Cumulative Wt%	Mean density (g/cm ³)
-0.075	24.64	24.64	2.55
0.075-0.15	34.43	59.07	2.48
0.15-0.3	12.62	71.69	2.58
0.3-0.6	14.89	86.58	2.66
0.6-1	13.42	100	2.54
		Mass fraction ave density	2.55

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC, EGG-WTD-9749, June 1991.

Table 3-6. Cation exchange capacity of RWMC soil.

Particle size (mm)	Cation exchange capacity ^a (milliequivalent/100 grams)	
	Ashed	Unashed
0.6-1	17.7	17.2
0.3-0.6	13.9	15.5
0.15-0.3	15.0	16.0
0.075-0.15	13.3	15.0
-0.075	13.3	13.3
Unclassified	11.6	15.0

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Portion of sample <1 mm blended (44.5% <1 mm), EGG-WTD-9749, June 1991.

Table 3-7. Mineral content of RWMC soil.

Typical breakdown: 37 wt% quartz, 48 wt% clay minerals, 10 wt% calcite, and 5 wt% minor constituents.

Mineral species	Wt% of species ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	-0.075 mm
Quartz	37.46	35.98	34.67	34.68	39.24	37.77
Ill/Mont-Random	25.77	23.08	28.22	26.26	25.04	27.09
Fe-Illite/Nontronite	10.71	13.76	14.12	11.88	9.08	9.59
Calcite	9.92	10.34	9.68	10.07	8.86	10.50
Illite	8.35	4.70	6.37	7.16	6.70	8.94
Chlorite-Mg	3.33	4.57	2.41	4.49	4.54	3.31
Rutile	0.74	0.78	0.76	0.81	0.66	0.70
Andesine	1.33	4.64	2.41	0	0	0
Hydrous Phosphate	0.37	0.40	0.38	0.43	0.34	0.39
Microcline	1.98	1.79	0.94	1.15	2.85	1.42
Oligoclase	0	0	0	3.16	2.63	0.24

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Mineral Content as a function of particle size for RWMC soil. Portion of sample <1 mm blended (44.5% < 1 mm), EGG-WTD-9749, June 1991.

Table 3-8. Chemical composition of RWMC soil.

Typical composition: SiO₂ 64.0 wt%, Al₂O₃ 11.0 wt%, Fe₂O₃ 4.0 wt%, FeO 0.7 wt%, CaO 7.0 wt%, K₂O 2.0 wt%, MgO 2.0 wt%, Organic 0.5 wt%, TiO₂ 0.7 wt%, Na₂O 0.3 wt%.

Compound	Wt% of compound ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	-0.075 mm
SiO ₂	64.81	63.57	64.20	63.17	66.37	64.92
Al ₂ O ₃	11.15	11.09	11.46	11.67	10.91	11.05
Fe ₂ O ₃	3.70	3.97	3.78	3.85	3.17	3.40
CaO	6.84	7.22	6.87	7.00	6.09	7.13
K ₂ O	2.26	2.21	2.14	2.24	2.25	2.20
MgO	2.14	2.41	2.13	2.46	2.39	2.20
H ₂ O ⁻	3.50	3.28	4.90	5.29	4.12	5.05
H ₂ O ⁺	2.51	2.51	2.54	2.64	2.48	2.52
CO ₂	4.36	4.54	4.25	4.42	3.90	4.61
TiO ₂	0.735	0.780	0.756	0.805	0.657	0.699
FeO	0.698	0.738	0.806	0.810	0.798	0.753
FeS ₂	0.019	0.019	0.019	0.019	0.019	0.019
Na ₂ O	0.252	0.423	0.454	0.382	0.409	0.205
BaO	0.094	0.093	0.088	0.094	0.092	0.089
P ₂ O ₅	0.192	0.206	0.198	0.222	0.179	0.202
Organic	0.54	0.56	0.76	0.87	0.64	0.68

a. Sample (one ten gallon drum, 35 kg) collected from the Lost River Spreading Area A adjacent to the RWMC which is commonly used as a source of soil fill for the RWMC. Chemical composition as a function of particle size for RWMC soil. Portion of sample <1 mm blended (44.5% <1 mm), EGG-WTD-9749, June 1991.

Table 3-9. Particle size distribution and mean density of Rocky Flats Plant soil.^a

Particle size distribution of as received RFP soil

Particle size (mm)	Wt%	Cumulative Wt%
-0.075	5.2	5.2
0.075-0.15	16.3	21.5
0.15-0.3	18.7	40.2
0.3-0.6	16.8	57.0
0.6-1	7.5	64.5
1-2.36	6.9	71.4
2.36-37.5	28.6	100

Particle size and density distribution of RFP soil. Portion <1 mm blended (64.5% <1mm)

Particle size (mm)	Wt%	Cumulative Wt%	Mean density (g/cm ³)
-0.075	8.0	8.0	2.51
0.075-0.15	25.2	33.2	2.47
0.15-0.3	28.9	62.1	2.41
0.3-0.6	26.1	88.3	2.54
0.6-1	11.7	100	2.63
		Mass fraction ave density	2.49

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad, EGG-WTD-9749, June 1991.

Table 3-10. Cation exchange capacity of RFP soil.

Particle size (mm)	Cation exchange capacity* (milliequivalent/100 grams)	
	Ashed	Unashed
0.6-1	5.5	9.4
0.3-0.6	7.8	32.7
0.15-0.3	15.5	37.7
0.075-0.15	16.1	35.5
-0.075	12.8	27.2
Unclassified	13.3	34.4

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Portion of sample <1 mm blended (64.5% < 1 mm) EGG-WTD-9749, June 1991.

Table 3-11. Mineral content of Rocky Flats Plant soil.

Typical breakdown: 47 wt% quartz, 38 wt% clay minerals, 13 wt% feldspars, and 2 wt% minor constituents.

Mineral species	Wt% of species ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	<0.075 mm
Quartz	47.23	68.51	48.48	41.70	39.07	39.86
Illite-Ca	20.76	13.99	16.57	17.77	20.88	20.84
Microcline	7.68	6.12	11.36	4.42	4.00	1.21
Ill/Mont-Random	12.45	9.09	9.94	25.39	18.79	18.76
Chlorite-Fe	4.23	0.46	1.68	0.23	2.34	1.96
Labradorite	4.92	0	5.64	3.86	0	0
Fe-Illite/Nontronite	0.04	0	4.97	2.38	3.51	4.20
Andesine	0	0.68	0	0	7.98	10.32
Rutile	0.56	0.26	0.45	0.62	0.68	0.70
Calcite	0.42	0.60	0.38	0.11	0	0
Hydrous Phosphate	0	0.26	0	0	0.46	0.46
Pyrite	0.09	0.02	0.02	0	0.11	0.09
Apatite	0.40	0	0.43	0.50	0	0
Pyroxene	1.04	0	0	1.71	1.43	0.95
Mg-Siderite (Mg 15)	0	0	0	1.01	0	0
Dolomite	0	0	0	0	0.49	0.53

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Mineral content as a function of particle size for RFP soil. Portion of sample <1 mm blended (64.5% < 1mm), EGG-WTD-9749, June 1991.

Table 3-12. Chemical composition of Rocky Flats Plant soil.

Typical composition: SiO₂ 75.0 wt%, Al₂O₃ 11.0 wt%, Fe₂O₃ 2.0 wt%, FeO 2.0 wt%, CaO 2.0 wt%, K₂O 3.0 wt%, MgO 1.7 wt%, Organic 6.0 wt%, TiO₂ 0.7 wt%, Na₂O 0.5 wt%.

Compound	Wt% of compound ^a					
	Unclassified	1-0.6 mm	0.6-0.3 mm	0.3-0.15 mm	0.15-.075 mm	-0.075 mm
SiO ₂	74.14	85.00	76.15	72.24	70.69	70.88
Al ₂ O ₃	11.29	6.78	10.83	12.40	13.02	12.97
Fe ₂ O ₃	1.90	1.32	2.49	2.78	2.90	3.01
FeO	1.87	0.63	0.79	1.58	1.71	1.61
CaO	1.90	0.99	1.76	2.10	2.10	2.03
K ₂ O	3.16	2.32	3.37	3.30	3.20	3.17
MgO	1.78	0.64	1.35	1.60	1.83	1.73
H ₂ O ⁻	12.83	5.29	9.54	17.23	12.79	12.11
H ₂ O ⁺	2.05	1.12	1.68	2.15	2.25	2.22
CO ₂	0.19	0.30	0.17	0.54	0.40	0.27
TiO ₂	0.554	0.758	0.452	0.615	0.677	0.698
FeS ₂	0.094	0.019	0.019	0.019	0.112	0.094
Na ₂ O	0.467	0.224	0.686	0.438	0.741	0.811
BaO	0.066	0.044	0.066	0.072	0.071	0.069
P ₂ O ₅	0.204	0.133	0.184	0.217	0.239	0.238
Organic	5.87	3.50	5.83	10.55	6.32	5.50

a. Sample (18 one gallon cans) collected about 150 yards southeast of 903 Pad. Chemical composition as a function of particle size for RFP soil. Portion of sample <1 mm blended (64.5% < 1 mm), EGG-WTD-9749, June 1991.

3.1 References

- 3-1. Radioactive Waste Technical Support Program, *Department of Energy Waste Treatability Group Guidance*, DOE/LLW-217, Rev. 0, January 1995.
- 3-2. J. H. Lee, G. P. Martins, J. R. Weidner, *Characterization Studies on: a) Contaminated Batch of Rocky Flats Soil, b) Uncontaminated Batch of INEL Soil*, EG&G-WTD-9749, June 1991.

